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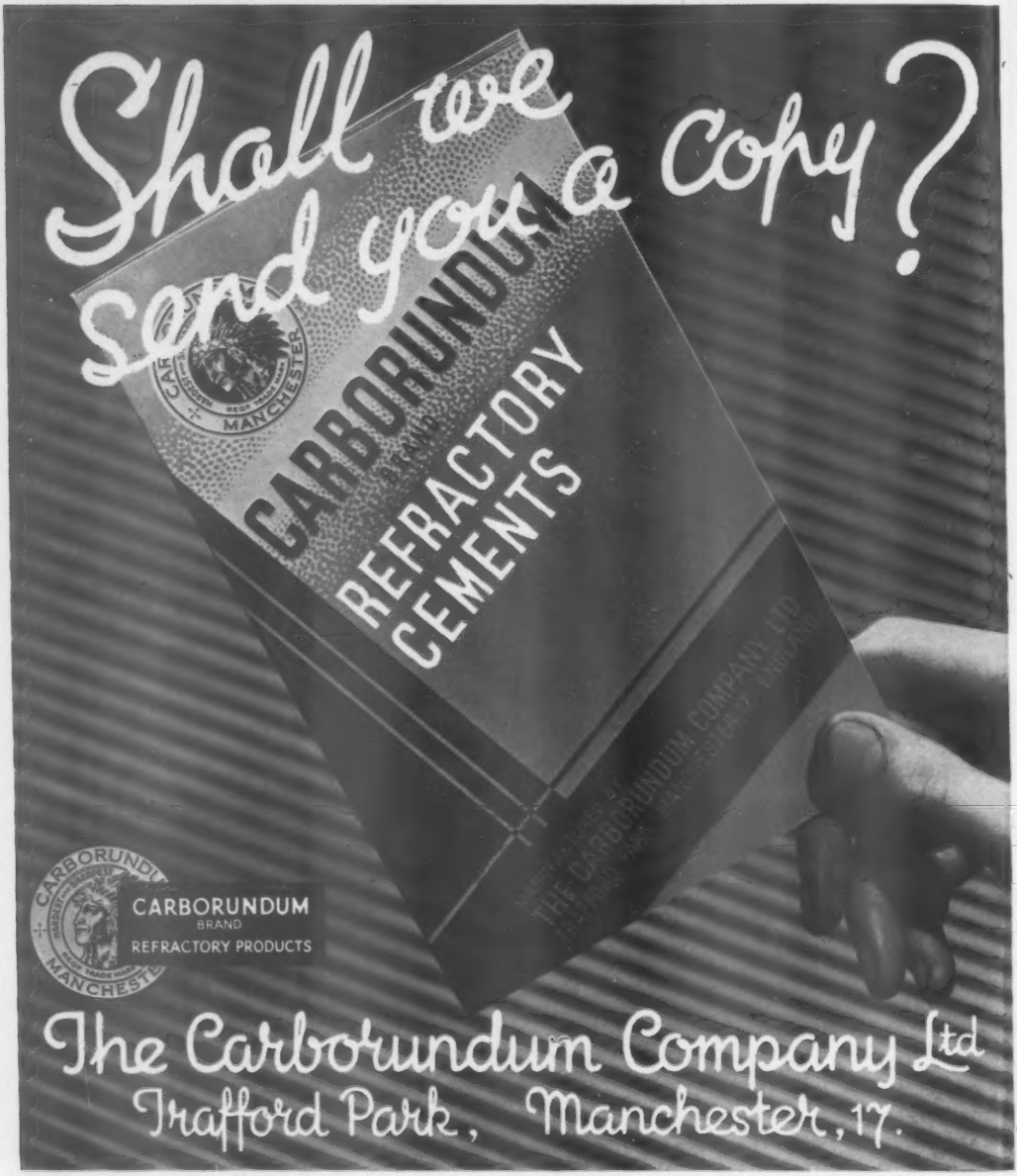
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FOUNDRY TRADE JOURNAL
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Vol. 69 Thursday, January 28, 1943 No. 1380

Anti-Blitz Precautions

Recently members of the Institution of Mechanical Engineers have been giving considerable thought to the subject of the proneness to damage of plant through enemy action, the discussion centring around a Paper presented by Mr. Hal Gutteridge. This Paper classified and gave proneness numbers to the various types of plant to be associated with a large engineering works. Such a study obviously provides an excellent basis for creating measures designed to give a maximum of protection against bombing. So far as foundries are concerned, the conditions vary so greatly that it is difficult to do more than enunciate generalisations. For instance, in one case a shop received three high explosive bombs, yet work was resumed after the delay of but one hour. Contributors to the discussion in question were unanimous that fire does more irreparable damage than does blast, and hence the necessity for proper and complete organisation of fire guards. Moreover, the water used in extinguishing a fierce fire can do more damage than the actual conflagration. One case cited was that the damage done by fire amounted to £17,000 and by water £121,000, whilst in a second the figures were £500 and £17,000. In the average foundry the places most prone to damage are the drawing office, the patternshop and stores, and the despatch department, whereas the shops least prone are those devoted to fettling, coremaking and moulding. Naturally, the more intense the mechanisation, the greater the proneness to damage, cardinal points being the air compressors, the switchboard, electric motors and, where they exist, the transformers. Just as in a large machine shop, one special duty machine tool needs special protection by means of blast walls, so, too, does any piece of plant, upon the continuous functioning of which the whole production of the foundry depends. A useful hint given in the discussion was that, in shops working day shift only, the overhead crane should be run up to the gable end of the building, for in this position it is not exposed to so great a risk as if left in the middle of the runway. The author, in his reply to the discussion, very rightly stressed the necessity for speed in reclaiming plant after damage by fire and water, because for many types of machines, especially electrical plant, deterioration sets in very rapidly, and unless attention is given reasonably quickly, they will become total casualties. The damage proneness number of any piece of plant becomes changed for the worse if the hazard be allowed to become greater by accumulations of inflammable matter. This precept applies with great force to the patternshop, but through carelessness it can obtain in the foundry also. We do not suggest that it is incumbent upon foundry managers to classify their plant with the object of establishing proneness numbers, but we strongly advise that when on fire-guard duty, thought should be given to the subject and in some cases action should be taken to reduce the risk by the usual means.

American Tinplate Industry

That the revolution in the American tinplate industry, from the hot-dipped to the electrolytic method, is expected to make rapid headway is reflected in the estimate of a competent American trade authority that the production of electrolytic tinplate in 1943 is likely to exceed the hot-dipped production by 50 per cent. A preliminary estimate of 1943 production places the electrolytic product at 50 per cent., bonderised plate at 15 per cent. and hot-dipped tinplate at 35 per cent. of a total of around 2,600,000 tons. Assuming that the electrolytic plate will carry a tin coating of a little over 0.5 per cent., that the hot-dipped product will run between 1.25 and 1.50 per cent., the tin requirements of the American tinplate makers in 1943 will be not over 20,000 tons of primary tin as compared with the high level of 48,000 tons in 1941 and an average of about 37,500 tons for the five years ending 1940.

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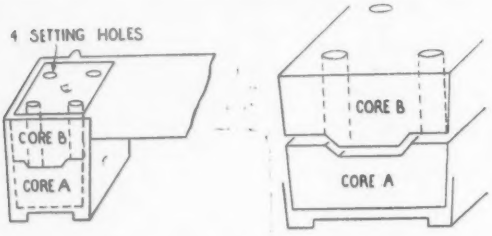
CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Bedplates

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—May I make a suggestion to "W.G.," *re* the making of the bedplate, as described in the Journal of December 3, 1942. Instead of using a drawback, the mould should be made in the usual way. The core (Fig. 2), however, could be made in halves, as shown here. The two cores could be assembled



before putting into the mould, to make sure that the cores came together correctly. A little chalk, plaster of paris, or flour, could be dusted on to the joint of core A to throw up the light when core B was being lowered into position. If four holes were left in core B in the position shown in Fig. A, the placing of this core would be simplified.—Yours, etc.,

T. SMITH.

39, Harewood Road,
Allestree, nr. Derby.

Mould Drying

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The article by K. E. Walker on "A Rapid and Economical Mould Drying Process" was read by ourselves with a good deal of interest, because for the past ten years the process has been standard practice in the non-ferrous foundry with which we are connected.

The process is all that Mr. Walker claims for it, but regarding its unsuitability for oil-sand cores we should like to express our strong disagreement, as thousands of oil-sand cores for phosphor-bronze castings of all shapes and sizes have been painted with the mixture.

Further, Mr. Walker makes no mention of the saving of time and labour in the dressing shop, a not inconsiderable item, and, looked at from this angle, it is very desirable to have the process cover all sizes of phosphorised bronze castings, even if they are of the type which are not usually "stoved." There is also a further saving in the machine shops, in the matter of tool life, there being no rough sandy surface such as is usually found on certain types of phosphorised bronze castings when cast "green."

In addition, the process has been applied to iron castings up to two tons in weight and to certain other alloys with casting temperatures as high as 1,500 deg. C.—Yours, etc.,

"TWO SAND-BLASTERS."

Manchester.
January 20, 1943.

SIR WILLIAM ROBERTS-AUSTEN CENTENARY LECTURE

To commemorate the birth, one hundred years ago, of Sir William Chandler Roberts-Austen, a lecture on his life and work will be given by Dr. S. W. Smith, C.B.E., on Wednesday, March 3, 1943, at 5.30 p.m. at the Institution of Mechanical Engineers, Storey's Gate, S.W.1. The lecture is being arranged jointly by the Institution of Mechanical Engineers, the Iron and Steel Institute, and the Institute of Metals, and it is expected that the chair will be taken by the President of the Institution of Mechanical Engineers.

Sir W. C. Roberts-Austen was an Honorary Member of the Institution of Mechanical Engineers, and he conducted a notable series of researches for the Alloys Research Committee of that Institution; he was President of the Iron and Steel Institute in 1899-1901, and his name is perpetuated in the literature of ferrous metallurgy by the word "austenite." His concern with non-ferrous metals and alloys was very close, both as a teacher of metallurgy—he held the chair of metallurgy at the Royal School of Mines, South Kensington—and as Chemist and Assayer of the Royal Mint.

Dr. Smith, who will deliver the lecture, in 1914 wrote a book "Roberts-Austen; a Record of his Work," and acted as Sir William's private assistant at the Royal Mint.

EDWARD WILLIAMS LECTURE, 1943

The Institute of British Foundrymen announces that the Edward Williams Lecture for 1943 will be delivered by S. F. Dorey, D.Sc., Wh.Ex., Chief Engineering Surveyor, Lloyd's Register of Shipping. The title which Dr. Dorey has selected is "The Contribution of the Steelfounder to Marine Engineering." The lecture will be presented to the annual meeting of the Institute, to be held in London on June 26.

Magnesium Fire Extinguisher

A product reported to extinguish magnesium fires and bombs, instead of merely confining the fire, is announced by Waverly Petroleum Products Company, Philadelphia. Known as Speedi-Out, it operates by cutting off completely the supply of oxygen from the bomb. In a demonstration test the product completely extinguished a magnesium fire bomb in 2 min. 53 secs. The product is a hard coal-tar pitch that is non-abrasive, non-corrosive and non-toxic. It has a 6/35 mesh with a softening temperature exceeding 300 deg. F.

THE PRODUCTION OF ALUMINIUM BRONZE CASTINGS

A Review of Modern Technique in a rapidly-expanding Branch of Foundry Practice

By FRANK HUDSON*

The production of aluminium bronze in the form of ingots, billets, sand and die castings has increased enormously since the outbreak of war, and a further increase in production may be anticipated following the recent issue of British Standard Specifications 1031-2 and 1072-3. It would appear that the maximum productive capacity of available plants producing wrought articles and die castings has been nearly reached, and the immediate tendency will be for the engineer to explore the market for sand castings where spare capacity undoubtedly exists, but where so very often the necessary knowledge in the handling of

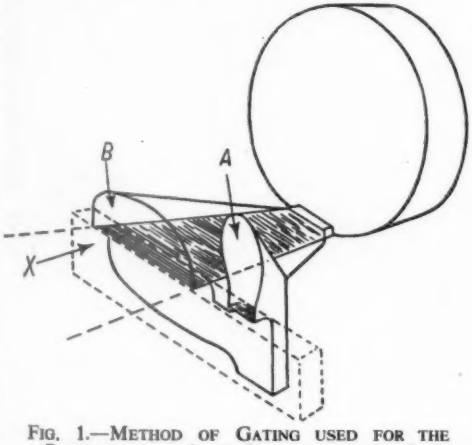


FIG. 1.—METHOD OF GATING USED FOR THE PRODUCTION OF SAND CASTINGS BY THE DURVILLE PROCESS.

aluminium bronze is lacking. It is therefore felt that practical non-ferrous foundrymen throughout the country will welcome some up-to-date notes on the production of alloys in this group.

Very little information has been so far published on the matter, and probably the best source of reference available is the book "Aluminium Bronze," published just before the war by the Copper Development Association. This work contains much of interest to the foundryman, and it would be a waste of time to reiterate the fundamental matters appertaining to casting production so well outlined in this publication. It is therefore the intention of the author at this time to supply data of a supplementary nature, which when used in conjunction with the above may conceivably make the picture more complete in the light to to-day's requirements.

* A Paper read before several Branches of the Institute of British Foundrymen.

Production of Ingots, Billets and Castings of Simple Form

Durville Process.—So far as the manufacture of ingots and billets are concerned, little change has taken place during the past few years, and production by the Durville process remains more or less the

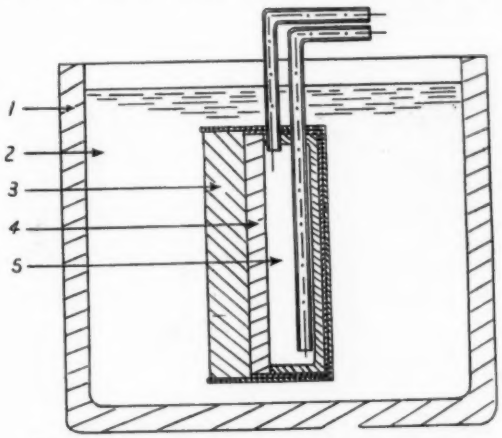


FIG. 2.—IMMERSION CASTING PROCESS (ERICHSEN). (1)—Melting or holding furnace. (2)—Liquid metal. (3) Solidified metal cake. (4) Cooled base-plate of mould. (5)—Circulating space for coolant.

standard method. Ingots produced in this way appear to satisfy normal production needs, providing care is taken to avoid turbulence in transferring the molten metal from melting furnace to the ladle or crucible attached to the Durville casting plant. The process could probably be improved if the transference of molten metal were avoided by so designing the equipment that it will take a "lift-out" crucible direct or alternatively form an integral part with the melting unit.

As well as being utilised for the production of

Aluminiu n Bronze Castings

ingots, tilting methods along Durville lines have been applied with some advantage in this country to sand moulds in the production of castings of simple shape providing a flow of metal in one direction can be obtained. There seems to be little advantage in applying the Durville method to castings of more complicated form where uni-directional metal flow is not obtainable.

The main point in applying the Durville method to sand castings is the provision of a suitably designed runner and ingate system as shown in Fig. 1. The pouring basin, runner and ingate are cut out of the mould by hand, a block core being inserted at X to obtain a partial reservoir of molten metal. This reservoir differs from that used in the production of ingots, inasmuch as it is not intended to hold all of the metal required to run the casting. It is only designed to hold enough metal to keep back surface dross and to allow the clean metal underneath to enter the mould. Pouring is commenced with the

FIG. 3.—PROPELLER CAST IN A SAND MOULD SPRAYED WITH NICKEL AND USING AN INERT ATMOSPHERE OF ARGON.

mould on an inclined plane, perhaps 60 deg. or more, and the runner A and ingate are filled to a point when metal is just about to enter the mould cavity as shown by the shaded area. Control of this operation can be exercised by watching the rise of the metal through the large riser opening B or alternatively by setting the block core to act as an overflow. The mould is now gradually lowered to a horizontal position whilst pouring is completed.

Immersion Casting Process.—Apart from the Durville process the only other method likely to be of interest in connection with the production of aluminium-bronze ingots is the immersion casting process (1) recently developed by Erichsen in Germany for light alloys.[1] Erichsen argues that a flawless ingot for semi-finished goods should be produced under the following conditions:—

(1) Solidification must take place in one direction only, as impurities and gases liberated on solidification are expelled from the ingot by crystals growing in only one direction.

(2) To avoid segregation of individual alloy constituents, solidification must take place in all parts of the ingot under the same conditions; it is therefore desirable that the speed of solidification should be the same in all parts of the ingot.

(3) To prevent porosity the solidifying layer of the ingot must be as thin as possible, and must remain

FIG. 4.—INCORRECT METHOD OF GATING ALUMINIUM BRONZE CASTINGS.

in contact with liquid metal so that shrinkage on solidification can be fully compensated.

(4) Ingots possess a weak bond in places where crystal structures grown from different directions meet, even if they are not separated by impurities. This is a further reason for uni-directional growth of crystals.

(5) To avoid the formation of metal oxides the contact of liquid metal with air must be avoided whilst the mould is being filled.

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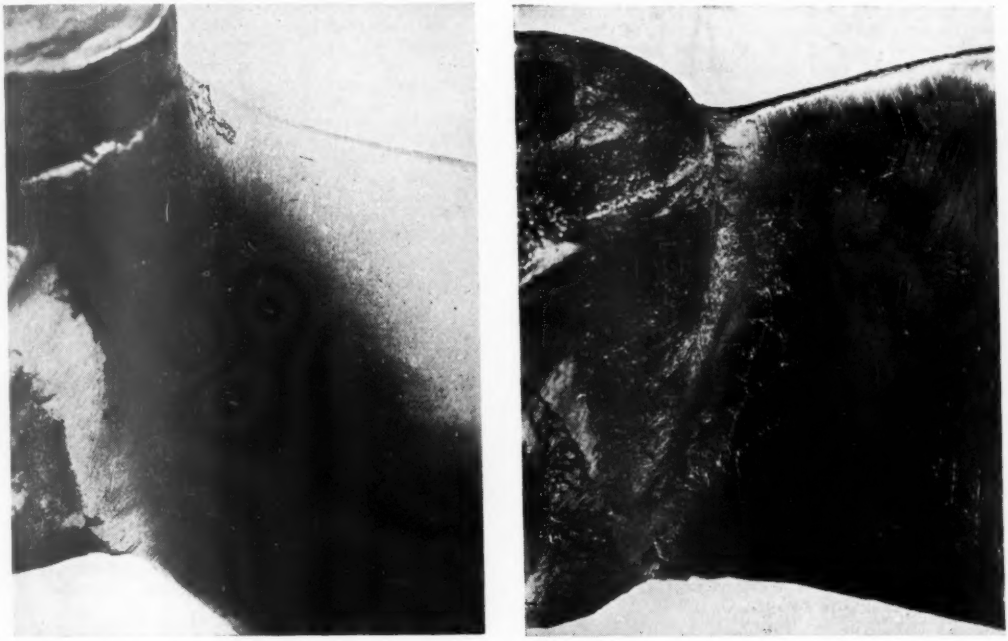
(1) A New Process for Casting Ingots: The Immersion Casting Process, by Sven F. Erichsen. Metallwirtschaft, 1941, Vol. 20, pp. 270-275.

Aluminium Bronze Castings

(6) In order to obtain ingots of the highest quality all unnecessary transport of the liquid metal must be avoided.

(7) In order that the casting process should be widely used in practice, it must be foolproof and capable of being operated by unskilled labour.

melting point, such as aluminium bronze. It is important to note that the rate of solidification of the slab depends upon the temperature of the melt, and in the case of aluminium, for example, the temperature of the molten metal bath must not be more than 70 deg. C. over the melting point. Certainly, if this process can be applied to aluminium bronze, it may conceivably produce ingots of superior quality to those at present made by the Durville method.



A.—Top Cast Surface of Blade. B.—Bottom Cast Surface of Blade.

Fig. 5.—Dross and Oxide Patches in Surface of Casting run as shown in Fig. 4.

None of the more common methods of ingot production comply entirely with these conditions, and with these facts in mind Erichsen has put forward the immersion process as meeting them all. Briefly speaking, this new casting process consists of dipping a mould of special design, as shown in Fig. 2, into a bath of molten metal and by rapidly abstracting the heat from the metal within the mould, solidification in the bath is effected. It is claimed that this method is particularly adapted to the production of slabs as used for rolling sheets and, whilst so far the immersion process has only been applied to duralumin, there is no reason why it should not be applied to metals with a higher

Centrifugal Casting Methods

Little mention need be made of centrifugal casting methods for the manufacture of cylindrical products, such as bushes and gear blanks, etc., in aluminium bronze, except to confirm that production by both horizontal and vertical machines is well established.

Turbulence of the molten metal during the casting operation must be kept at a minimum in order to prevent excessive drossing. Accordingly, the best practice is to pour so that the metal strikes the rotating mould as nearly as possible in the centre of the base, where rotation speed is lowest. The plane of rotation may vary from the vertical, in the case of castings where

Aluminium Bronze Castings

the diameter greatly exceeds the length, *e.g.*, gear-wheel blanks, to the horizontal for castings where length is much greater than diameter, such as is common to pipes and tubes. In America spinning around an inclined plane is widely practised. As the angle of the shaft is decreased, the dirt and dross begin to spread down the bore instead of being concentrated at the top, and the best operating angle will be reached when the bore shows an even distribution of impurities over its entire length. For the latest information on the production of spun aluminium bronze castings re-

FIG. 6.—CORRECT METHOD OF GATING ALUMINIUM BRONZE CASTINGS.

ference should be made to a paper recently published by Zuehlke.[2]

Production of Sand Castings

Use of Inert Atmospheres and Moulds.—So far as the production of sand castings is concerned, it has long been recognised that the usual methods of founding as employed for brass and bronze do not give satisfactory results with aluminium bronze. In a recent Paper[2] the author gave a few suggestions as to how it might be possible to bring the founding of aluminium bronze into line with the more common alloys, and these suggestions have now been tried out in actual practice. It had been hoped, for example, that by pouring through an inert atmosphere into an inert mould filled with an inert gas there would be little need for the special gating methods put forward to avoid turbulence and consequent oxide formation. Little difficulty was experienced in obtaining the inert atmospheres both in the mould and during pouring by means of argon, a heavy gas widely used to fill electric lamp bulbs, but considerable difficulty arose in obtaining an inert mould. It will be appreciated that even a dry sand mould will evolve water vapour when poured, due to dissociation of the combined water in the clay bond, unless the mould is dried at temperatures above 600 deg. C., which corresponds to a dull red heat, and any evolution of moisture from the mould will of course make the applied inert atmosphere ineffective. The drying of complete moulds and cores at such high temperatures was considered impracticable, and as an alternative it was decided to metal spray the mould surface with nickel in order to avoid water vapour contaminating the argon atmosphere inside the mould. A small marine propeller mould was selected for these preliminary experiments and a series of castings made in an atmosphere of argon using ordinary dry sand moulds with and without a nickel sprayed surface. These trials, whilst not giving the results desired, were distinctly useful, enabling the following

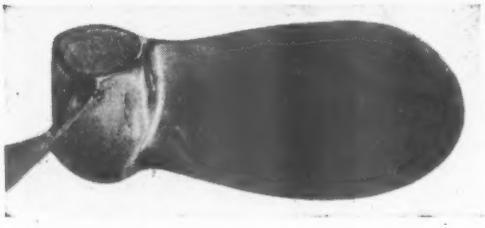


FIG. 7.—APPEARANCE OF CASTING RUN AS SHOWN IN FIG. 6, AFTER POLISHING. BLADE CLEAN AND FREE FROM DROSS.

conclusions to be drawn:—(1) Whilst the use of an inert atmosphere in conjunction with dry sand moulds results in an improvement of the casting surface, it does not completely eliminate surface defects due to aluminium-oxide inclusions and turbulence in pouring must still be avoided; and (2) spraying the mould surface with nickel is not helpful even when pouring is conducted in an inert atmosphere. The sprayed coating expands and buckles during the casting operation, with the consequent formation of many depressions on the surface of the casting and, furthermore, there is a tendency for the molten metal to get behind the mould coating. These types of defects are clearly shown in Fig. 3, which illustrates a section of a propeller blade taken from one of the trial castings produced.

Further work on commercial methods for producing inert moulds is clearly needed before full advantage can be taken of the use of inert gases as a means to avoid oxide formation, and the most

(2) "Producing Non-Ferrous Castings Centrifugally", by Harold B. Zuehlke, The Foundry, Oct. 1942, page 68.

(3) "The Production of Aluminium Bronze Castings", by Frank Hudson, Metallurgia, Oct. 1941, page 187.

Aluminium Bronze Castings

likely direction for research in this connection will probably lie in the development of a mould facing sand or wash which will not evolve water vapour in contact with molten aluminium bronze. It might be suggested, for example, that a facing made from

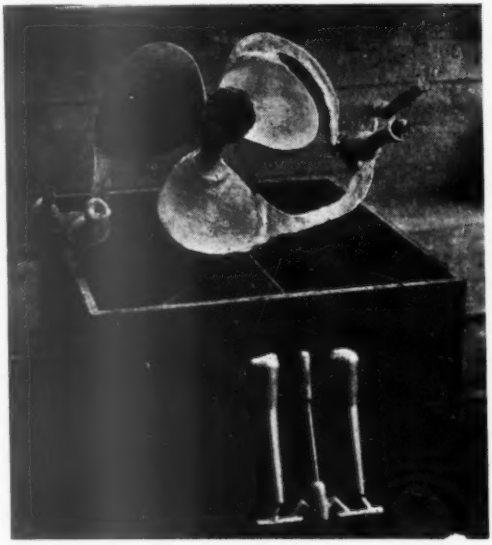


FIG. 8.—ANOTHER SATISFACTORY METHOD OF RUNNING ALUMINIUM BRONZE CASTINGS. (*Courtesy of J. Starkie Gardner, Limited.*)

washed silica sand, of the necessary grain size, free from lime or shell particles, such as Leighton Buzzard, and bonded with a solution of sodium silicate, will have the desired effect. This facing could be used in the normal way with ordinary dry sand providing due recognition is taken of the fact that it will possess a rather low green bond strength, and its application therefore should not be overdone. The mould can then be dried in the usual manner, sprayed or brushed with a wash made from plumbago bonded with sodium silicate, then, and this is the important point, the surface of the mould should be heated to a dull red heat by means of a powerful gas torch or blow-lamp flame.

Alternatively crushed old firebricks or sillimanite might be used as the basis of the facing material, and some consideration could be given to the future possibility of utilising the silicon esters for bonding purposes. In Dietert's book, "Modern Core Practices and Theories," published last year by the American Foundrymen's Association, some data are given in connection with the last group of materials. It should, however, be noted that due to the war there is a shortage of materials used to manufacture silicon esters, and they are therefore at present not available for general use.

Quite apart from the development of special facing materials to render a sand mould inert it might, of course, be possible to get the required conditions by simply spraying the surface of an ordinary dry sand mould with sodium silicate, dusting with plumbago, and then, after drying, heating the surface to a dull red by means of a blow-pipe flame as previously suggested. It will, of course, be necessary to treat all cores in a similar way as that suggested for moulds.

Methods of Gating

So much for future developments, but what

FIG. 9.—UNDERSIDE VIEW OF FIG. 8 (*Courtesy of J. Starkie Gardner, Limited.*)

about the present? With the knowledge available quite good commercial castings in aluminium bronze can be produced providing due care and attention is given to running and feeding methods. Gating methods are particularly important, and it is no exaggeration to say that this point probably constitutes the major factor to-day in the production of sand castings. Turbulence of the metal, either during pouring or in the mould, must be avoided at all cost, and a great deal of emphasis has been given to this matter by previous writers.[4] It is therefore unnecessary further to labour this point, but it might be of interest to show a comparison of good and bad gating methods as actually found in practice.

Fig. 4 illustrates the wrong way of gating an aluminium bronze casting. In avoiding turbulence the

(*) See book on "Aluminium Bronze" published by Copper Development Association.

use of a horn gate is an obvious suggestion, but the usual type as shown in this illustration does not give satisfactory results with aluminium bronze, in that a fountain effect is produced with considerable metal disturbance inside the mould cavity, leading to the presence of dross and oxide particles, as shown in Fig. 5. Incidentally it might be noticed that in the propeller casting shown these oxide particles predominate at the root of the blade, the area most highly stressed in service.

A better method of utilising the horn gate in the running of aluminium-bronze castings is outlined in Fig. 6. In this example the ingate has been inverted so that the diameter increases towards the casting,

FIG. 10.—METHOD OF FINISHING ROOT AREA OF PROPELLER BLADES PREPARATORY TO POLISHING. (*Courtesy of J. Starkie Gardner, Limited.*)

thereby reducing jet effect and minimising turbulence. A dirt trap has also been included as an ameliorative. The shape of the feeding head in this example could be improved with advantage, as shown by the inscribed line. Fig. 7 illustrates a propeller made by this method, and it will be observed that it is quite a satisfactory casting, clean, and free from dross inclusions.

Figs. 8 and 9 show another very successful method adopted for gating small aluminium-bronze propellers, namely running them from the tip of each blade. This method has the additional advantage, over similar castings run from the centre boss, that directional metal flow is obtained, and any dross that may be formed is swept out of harm's way into the feeding head. Another interesting point is the provision of chills at the root of the blade in order to develop maximum mechanical properties in this section, particularly in regard to corrosion fatigue. It will be noticed that the chills are placed on the top of the blade only so that they do not materially reduce the temperature and fluidity of the metal going into the feeding head. Whilst this may not be of much importance when running propellers from the blade tips, it becomes a point of major moment when gating this type of casting from the boss, as the inclusion of chills on the bottom of the blade may cool the metal to such a degree as to cause misrun edges at the blade tips.

Comment has already been made of the importance of ensuring absolute freedom from defects at the root of the blade in the type of castings under immediate review. At present small propellers are finished by hand, and some trouble has been experienced in removing minor surface blemishes occasioned through the difficulty of obtaining a grinding tool sufficiently small enough to get down to work at this point. Fig. 10 illustrates a method

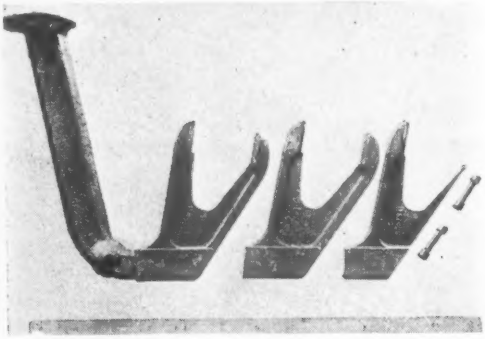


FIG. 11.—DIE CASTING WITH AND WITHOUT RUNNER AND SHOWING POSITION OF TENSOMETER TENSILE TEST-PIECES.

whereby this difficulty can be overcome incorporating the use of a rotary cutting tool mounted on the usual portable electric grinding wheel attachment.

Risers.—Little comment is needed in regard to the type of risers required for aluminium bronze. To overcome shrinkage difficulties large feeding heads must be provided, and when the application of these is not possible the use of chills should be employed at heavy change in section. Alternatively very close consideration might well be given to the Paper by Taylor and Rominski on "Atmospheric Pressure and the Steel Casting—A New Technique in Gating and Risering," given to the American Foundrymen's Association and recently published in THE FOUNDRY TRADE JOURNAL.[5] The method described in this Paper seems to work well with many non-ferrous metals, and should be particularly adaptable to the production of aluminium-bronze castings.

(5) FOUNDRY TRADE JOURNAL Oct. 15th, pp. 135-139, Oct. 22nd pp. 171-175, Oct. 29th, pp. 193-197, 1942.

Aluminium Bronze Castings

General Comments

Next to the question of method of gating, the most important single factor is probably casting temperature. The best working rule in this connection is to employ the lowest possible temperature consistent with the ability of the metal adequately to feed and flow freely to all parts of the casting.

The melting and alloying of aluminium bronze does not normally give rise to any really difficult problems, although minor considerations arise in wartime which tend to upset matters.

For example, it becomes necessary to utilise secondary metal as much as possible. Accordingly the non-ferrous founder may have to employ ingots made entirely from aluminium bronze turnings and other forms of scrap or, if accustomed to making up his own metal, have to depend upon secondary aluminium, etc., for alloying purposes. Whilst the use of these secondary metals does reduce the mechanical properties to some extent, particularly as regards elongation, they have very little effect on the actual production of castings required for the majority of applications. For certain specialised types of castings in the high tensile aluminium bronze class covered by B.S. Specification 1073, where maximum mechanical properties are essential to meet severe service conditions, the best results are undoubtedly guaranteed by the use of virgin metals.

So far as type of moulds are concerned, it is obvious from what has already been said that dry sand is to be preferred. Furthermore, a dry sand containing as little clay bond as possible and therefore a minimum of combined water most nearly meets the ideal requirements previously discussed. Until the latter is developed on a commercial basis, well dried synthetic sand moulds are most likely to give the best results and are undoubtedly superior to such alternatives as green and cement bonded sand, etc.

The soft soldering of aluminium bronze castings still remains something of a hit and miss affair, but both brazing and welding operations have been developed to a satisfactory level. In fact, so far as welding is concerned it is now possible to make a joint having a strength equal to, or even greater than, the parent metal. This is of particular value in connection with High Tensile Aluminium Bronze B.S. 1073, and it is interesting to note that Starkie Gardner & Company, Limited, of London, in conjunction with the firms of T. M. Birkett and Murex, Limited, will shortly market a flux-coated electrode suitable for use with the electric arc for welding this type of material.

Mechanical Properties

Coming now to the question of mechanical properties, no undue difficulty should be experienced in meeting those laid down in B.S. 1032 and 1073, providing the composition is correctly balanced. Of the two specifications, B.S. 1073 is the more difficult to meet and the ultimate tensile strength may tend to be below specificational requirements if the aluminium, iron, nickel and manganese are on the low side of the compositional range. Similarly, if the elements just mentioned are on the high side trouble may be experienced through lack of the necessary ductility. The presence of silicon, through the use of secondary aluminium as an alloying element, will still further aggravate matters. A good guide is to aim at obtaining a final casting having an analysis about midway between the low and top limits specified, considering any silicon present as replacing aluminium. The average properties of test-bars under normal conditions should be approximately as follow:—

B.S. 1032.—Proof stress, 0.2 per cent., 10 tons per sq. in.; max. strength, 34 tons per sq. in.; elongation on 2 in., 30 per cent.; Izod impact, 25 to 35 ft.-lbs.

B.S. 1073.—Proof stress, 0.2 per cent., 18 tons per sq. in.; max. strength, 42 tons per sq. in.; elongation on 2 in., 18 per cent.; Izod impact, 15 to 25 ft.-lbs.

Mild chilling tends to effect an all-round improvement in mechanical properties, but care must be taken not to overdo this, particularly in regard to the high

TABLE I.—*Mechanical Properties of Aluminium Bronze Propeller Castings Chilled at Root of Blade in Relation to Test Bars.*

Composition, per cent.						Test pieces 0.179-inch diameter, cut from root of blade.		Separately cast test bars 0.566-inch diameter.	
Al	Fe	Ni	Mn	Si	Cu	Maximum strength, Tons per square inch.	Elongation, per cent.	Maximum strength, Tons per square inch.	Elongation, per cent.
9.61	4.07	3.83	0.52	Nil	Bal.	47.5 46.0	34.0 35.0	42.4	16.0
8.70	4.34	3.87	0.90	0.07	Bal.	39.0 42.5	20.0 26.0	41.6	15.0

Aluminium Bronze Castings

tensile aluminium bronze. If too quick a cooling rate is obtained, in conjunction with material having an analysis approaching the higher limits of the compositional range, there is a tendency to get high tensile strength figures at the expense of ductility. Table I provides an actual comparison of the mechanical properties of aluminium bronze propeller castings made with chills at the root of the blade in comparison with separately cast bars. The casting and test-bar containing 9.61 per cent. aluminium were made from virgin metals, whilst the set containing 8.70 per cent. aluminium was alloyed with secondary aluminium, which accounts for the presence of silicon. In the absence of confirmatory evidence it would be unwise to state that the large difference in properties of the test-bars cut from the castings was due to the use of secondary aluminium, as there are so many other factors which must be taken into account. It is interesting to note, however, that the properties of the castings are equal to, or better than, the separately-cast bars which themselves provide a reasonable margin over the requirements laid down in B.S. Specification 1073. It has already been mentioned that the incorporation of chills at the root of the blade in these small propeller castings whilst tending to ensure the best mechanical properties also materially improve corrosion fatigue values. Actual fatigue tests conducted on sand and chill cast specimens in sea water spray give the following values for aluminium bronze to B.S. Specification 1073 on a basis of 50 million reversals: Sand cast, ± 8.5 to ± 9.5 tons per sq. in.; chill cast, ± 9.5 to ± 10.5 tons per sq. in.

TABLE II.—*Mechanical Properties of Aluminium Bronze Die Castings.*

Composition, per cent.						Tons per square inch.		Elongation, per cent.	Brinell hardness No. 10/3000/15.
Al	Fe	Ni	Mn	Si	Cu	Yield point.	Maximum strength.		
8.58	5.09	5.74	0.63	Nil	Bal.	24.0 23.5	47.5 46.4	22.0 27.0	169
11.19	4.70	5.13	0.54	Nil	Bal.	44.0 43.0	63.5 62.8	4.0 5.0	275

Die Castings

A Paper on aluminium bronze would not be complete without some reference to the production of die castings. Large quantities of high tensile aluminium bronze stampings and forgings are being produced for fighting machines and war equipment of various kinds with the tendency to overload the forge and press shops. Consideration might therefore be given to the possibility of substituting die castings for wrought or stamped articles in order to increase production. Admittedly existing aluminium bronze die casters may themselves have more work at present on their hands than they can cope with, but it is a much easier problem to increase the production of die castings than to increase the output of wrought goods, particularly if full advantage be taken in utilising iron dies cast to shape.

Apart from this aspect there is a scarcity of data on the mechanical properties of die castings, as the properties obtained from the usual size of test-bar bear little relation to the actual job. The figures shown in Table II, obtained from test specimens cut from the actual die casting, are therefore of considerable interest. As a matter of fact, this table summarises a series of tests on a range of compositions having fixed nickel and iron contents around 5 per cent., with approximately 0.5 per cent. manganese and an aluminium percentage varying from 8.5 to 11.0 per cent. It will be observed that within this range it is possible to produce die castings having mechanical properties varying from an average of approximately 47 tons tensile, with 24.5 per cent. elongation at 8.5 per cent. aluminium, to 63 tons tensile with 4.5 per cent. elongation at 11.0 per cent. aluminium, a truly remarkable range of properties for a non-ferrous material. Fig. 11 provides a view of the die casting which formed the subject of these tests and the method of obtaining the test specimens for record purposes.

One word of warning might be given at this moment regarding the properties of aluminium bronzes containing nickel. Those containing 5 per cent. nickel associated with an equal amount of iron provide the best and most reliable properties in production. The aluminium content may vary between a limit of 2 per cent. without serious detriment, and the alloy is completely stable under production conditions. On the other hand, there is a tendency to-day to employ a bronze having a similar composition to that given above except that the iron is omitted. Such an alloy requires much closer control in the foundry, and is inclined to give erratic results. The aluminium content must be maintained within limits of 0.5 per cent. either way, and furthermore it is not stable and tends to age-harden on slow cooling, such as might easily arise when castings are piled in a heap on the floor.

(*Concluded on page* 80.)

THE SUBSTITUTING OF HIGH-DUTY GREY IRON FOR STEEL CASTINGS

Discussion of Paper at December Meeting of the Lancashire Branch

By J. BLAKISTON, A.I.Mech.E.

Mr. J. Blakiston, A.I.Mech.E., repeated his Paper, "The Substituting of High-Duty Grey Iron for Steel Castings,"* which was originally read before the Annual Meeting of the Institute of British Foundrymen, to the December meeting of the Lancashire Branch, over which Mr. E. L. Howard presided.

The discussion was opened by MR. J. JACKSON (Accrington), who said people who were struggling with high-duty irons at the present time were faced, first of all, with a difficulty in obtaining adequate supplies of low-phosphorus pig-iron. There was, however, no difficulty in obtaining supplies of steel scrap. It had been always a specific aim of the Institute to promote the use of castings as against fabricated structures of any kind. When considering, at the present time, the whole basis of the use of high-duty iron, through the use of steel, he wondered sometimes how it would be possible to maintain the supply of 50 per cent. of steel scrap charge. Unfortunately it was not yet within the realms of probability to dephosphorise cast iron in a way similar to that used for desulphurising. He wondered whether there was any advantage gained by adding silicon in the cupola; would it not be better added in the spout? In the case of his own trials he had had better results by adding all the silicon at the spout instead of charging half into the furnace. There might be some advantage, of course, in adding ferro-silicon in the cupola.

Process Scrap Position

MR. BLAKISTON said, owing to some unspecified reason, apparently, steel manufacturing in this country and in America had got slightly out of balance in the ratio of open-hearth to Bessemer furnaces. A Bessemer furnace was a scrap producer, while an open-hearth furnace was a scrap consumer. On the Continent people worked on a more or less balanced ratio as contrasted with this country. There were relatively few Bessemer converters blowing in this country, and until this state of things was remedied there would probably be a shortage of scrap. It was anticipated, however, that there would probably be a glut of scrap after the war, including manganese steel.

With regard to the addition of ferro-silicon, the graph shown indicated that after the addition of 70 per cent. of silicon to the stream there was a definite falling off in strength. He only cited ferro-silicon as one inoculant. If silicide was added, there would not be probably more than one in fifty in order to obtain similar results.

* See FOUNDRY TRADE JOURNAL for July 9 and 16, 1942.

Basic Charge Materials

MR. H. P. HUGHES (Rochdale) said that designers could now safely say that the gap between cast iron and steel had been bridged. The fact that the illustrations of castings exhibited on the screen had in most cases replaced steel castings, indicated that a favourable position had been reached with regard to the substitution of high-duty grey iron. When Mr. Blakiston was detailing the material required for the production of high-duty cast iron in the cupola he cited a number of stock irons necessary for use. His personal opinion was that there was only one thing the founder needed for producing high-duty cast iron, namely, hematite iron. Another point which had interested him was the suggestion of a pound of ferro-silicon inoculant per 1 cwt. of metal in the ladle. This seemed to be a very high figure. It was realised that the metal must be as hot as possible, and, as a result, it was necessary to keep the inoculant down to a minimum figure. Anyone who was using ferro-silicon which contained fines should discard the fines as they gave most erratic results. This meant the loss of some material, although it gave superior results.

Mention had been made also that 20 per cent. shop scrap was a suitable quantity to use. Mr. Blakiston must be making very large castings if he only got 20 per cent. shop scrap back. Most of the high-duty iron required larger heads and more extensive feeding arrangements, the result being larger returns, so that 20 per cent. was an extremely low figure for returns from high-duty cast irons. Very little had been said with regard to the heat treatment of such high-duty cast irons, in regard to which there was an extensive field of inquiry open for the ironfounder to pursue. The properties of high-duty cast iron were greatly enhanced by heat-treatment. Most of the castings detailed were fairly large, and the facilities for heat-treatment needed to be extensive; but with smaller castings very superior properties, as far as tensile and transverse strength were concerned, could be produced by heat-treatment.

Exothermic Inoculants

MR. BLAKISTON agreed that matters might be simplified if there was a smaller selection for the stock, but personally he was in favour of having a large selection and averaging it out every time. This remark applied both to scrap and to pig-irons. If one were dependent upon one source of supply, and anything went wrong with that source of supply, a critical difficulty would be experienced, whereas if several sources of supply were available, and they were all blended, it would tend to cancel out any erratic working. The addition of ferro-silicon would

High-Duty Grey Iron as Substitute

not chill the metal as the reaction was heat-producing. The low percentage of shop scrap in the particular case he cited could definitely be increased by cutting down the amount of pig-iron. It was only taken as a typical case. In the foundry with which he was concerned they had both large castings and small castings, and it was really not necessary to be so particular, as the returns generally ran round about 20 per cent.

Acicular Structure Control

MR. A. HOPWOOD (Liverpool) asked Mr. Blakiston, in view of his graph and the narrow range which he gave for the production of acicular structure with a certain section, could he guarantee that he would get the results in the casting that he had in the test-bar? He had in mind the overcoming of the differences in cooling due to different methods of running adjoining sections, where, automatically, there would be increases of section, and also where there was the application of large risers which were necessary even in some of the simple designs of castings.

MR. BLAKISTON remarked that the trouble with the development of acicular irons at the present time was to get them consistent in all sections. Naturally, there was variation where risers and runners and things like that were placed. Probably this was the reason why the Americans favoured the super-cooling method of obtaining the acicular structure, when the whole casting was heated and then quenched, and there were even conditions obtaining throughout the casting. The alloy was in its pioneer state, and there was still much to learn about it. What was decided upon to-day would probably be all dead history to-morrow.

It was not a question of maintaining the tensile strength throughout the casting if it was inherently machinable. When getting a casting which Brinells at 350, and which was acicular, it was in the machinable range, but when it entered the martensitic range, the casting was useless because it could not be machined. An attempt was being made to eliminate the teething troubles which were being experienced by investigators with regard to this particular metal.

Disposition of Charge

MR. WADDINGTON (Manchester) said that in the case of the virgin mixture referred to, 20 per cent. of domestic scrap was added. Would it be possible to reduce the steel in the mix for domestic scrap? Also, the heavy material was put round the edge in the charge in the cupola. What was the theory underlying this practice?

MR. BLAKISTON said that up to 80 per cent. of steel could be safely melted in the cupola without experiencing difficulty, once the founder became used to the operation. If the steel was reduced the probability was that there would be an increase in carbon content. If it were desired to increase the carbon content well and good; but the steel was added in order to correct the carbon. If it was practicable to get 3 per cent. carbon with 10 per cent. steel, and if it suited the purpose, that course could be followed, but it was not the cheapest mixture. The more the steel added, the cheaper the mixture. One reason for placing the larger portions of the steel scrap to the outside of the cupola was a physical one; namely, that the material in the centre was caused to travel down quicker. The flow tended to go down from the centre, and naturally the bigger pieces were required to remain in the furnace for a longer time in order to make sure of getting them properly heated throughout. If they all tended to come to the middle —they did this in any case to some extent—there would be a tendency to jamming. It was necessary to keep the middle free for the smaller material.

Abrasion Resisting Properties Sought

MR. A. L. KEY (Manchester) said the engineer might be misled into thinking that with the advent of high-duty cast iron there was available something for which he had been waiting a long time; namely, a cure-all. Too much reliance should not be placed upon the term "high-duty," because "high-duty" in reference to cast iron functioned in various directions. Maximum strength was one direction, and was an essential quality. When undertaking internal combustion work the main essential was wearing property. He had made material of 14½ tons tensile which had proved to be unmistakably better from this angle than some of the high tensiles.

He had carried out a certain amount of experimenting himself as far back as the years 1913 to 1915. The material was made by a somewhat similar method as that described by Mr. Blakiston, but he used 50 per cent. of steel and not 70 per cent., and he obtained consistently good results. The highest tensile strength achieved was 20½ tons per sq. in. The machinability compared favourably with an ordinary commercial soft cast iron, and the turnings would take at least two, and sometimes three, curls in front of the tool before they broke off, indicating that the material must have been very good.

He could criticise the cupola method described, but the end justified the means. If Mr. Blakiston was obtaining the desired results that was all that was necessary, but they could be obtained by other means. The method described was different from that which he had worked himself, namely, with a lower bed and only about two-thirds of the blast pressure. It was highly desirable in melting high steel charges. He would be pleased to learn something concerning the wearing properties of what was termed high-duty cast iron as contrasted with ordinary cast iron made from other materials.

MR. BLAKISTON observed that the term "high-duty" had no connection with wear resistance. Cast iron could be produced, and also high-duty grey iron, in a variety of forms. High-duty iron could be produced to give wear resistance, but if it was merely produced with the object of obtaining high-tensile results it might not be suitable for wear resistance. In the latter part of his lecture he had shown a freak mixture which gave 3.4 per cent. carbon, 320

Brinell. That particular iron seemed to be an ideal one, and might have considerable potentialities for the purpose specified by Mr. Key.

Cast Steel Crankshaft

MR. HAROLD HAYNES (Ashton-under-Lyne) said that the crankshaft which had been made for a disabled ship which had put into an Australian port was very clever foundry work. Not long ago he saw a shaft, 20 in. to 2 ft. dia., which had been running for 100 years. High-duty iron was a coming thing in this country; it was only in its infancy at present. Designers should be invited to come more to the aid of the foundryman; it might be awkward to maintain a design in high-duty iron. What control could be exercised over castings carrying from ¼ in. to 3 in. thickness?

MR. BLAKISTON said that usually irregular metal sections could be dealt with by alloy additions, but this was an expensive method of overcoming the difficulty. Difficulty should be dealt with, initially, on the drawing board. Many up-to-date firms had given instructions that no finished drawing was to be issued into the works until the castings had been sanctioned and passed by the foundry manager. It was only by such foresight and by modern methods of working that advances could be made in this field of foundry work.

Runners and risers presented quite a problem for high-duty grey-iron castings, but not to those who had been engaged with steel castings, malleable work, or heavy bronze work, because the practice was very similar.

He did not know the particular methods of running certain of the castings illustrated on the screen, because he did not see them cast; he only saw the photographs of the finished article. In his own case, it was found that feeding flux, with large risers in the correct position and which were not strangled at the neck, generally enabled him to overcome any difficulties. Many people said that rod feeding should not be used with high-duty iron, as more would be pulled out than would be put in; yet rod feeding, correctly carried out, was beneficial.

Heat-Treatment of High-Duty Irons

MR. C. VAN DER BEN (Ashton-under-Lyne) said there were two points which were not quite clear to him in connection with the use of special alloys and the introduction of high-duty iron. He thought he was correct in saying that acicular structure could be produced by the use of either a silicide or silicon, when other alloys were necessary, in the event of producing an acicular structure. In that connection he did not quite understand the reference to heating up to 370 deg. C. In the case of ferro-silicon inoculations, he could not understand why any heat-treatment at such a temperature would have any effect whatever on the properties of the metal. He wished to be corrected if he was wrong.

In regard to the nickel or molybdenum types of high-duty iron, personally, he found no advantage in heat-treatment at such temperatures. Naturally, much depended upon the percentage of nickel and molybdenum present as to whether the temperature was above the critical point. Molybdenum had the property of very markedly reducing the critical temperature so that it did come down to quite low figures. From time to time, when castings had been inadvertently dealt with according to the normal practice in the case of ordinary irons, and had been knocked out at a dull heat, they had turned out as hard as flint because the iron was above its critical point.

His own view was that, if possible, heat-treatments involving a quench should be avoided. If it was possible to produce the required properties in the as-cast condition, that was the result sought. It involved more expense, but, when compared with the cost of heat-treatment, there was probably very little in it. Time was saved, and perhaps there was less chance of unseen, unsuspected defects occurring which might lead to trouble in the later life of the casting. He was referring now to strains and stresses and minute cracks developed through heat-treatment.

He had tried the straight quenching on plain and alloyed irons, and he had produced the acicular structure from the original pearlitic structure as-cast, but was not very much impressed by it.

Cost of Alloying

MR. BLAKISTON was in agreement with the last speaker's remarks, namely, that it was advisable if possible to produce these irons in the as-cast condition, speaking from the point of view of experience. The heat-treatment stipulation was on acicular irons containing a percentage of nickel and a percentage of molybdenum. About 0.8 per cent. of molybdenum added approximately £9 per ton to the cost of a casting at present-day prices. If the molybdenum could be eliminated, and the acicular structure produced without it, the result would be advantageous. Unfortunately, as present developments show, this could not be done without resorting to heat-treatment, which again involved expense.

Investigators were still in the pioneer stage as regards heat-treatment. As he had stated previously, it had been discovered in America that heat-treatment did not increase the impact resistance, but lowered it in the casting. In some experiments it was found that very often after a casting had been heat-treated the tensile strength of the iron was reduced to a small extent. Although he was convinced that the new iron had great possibilities of use, it was nevertheless necessary to find out more about it.

Centrifugal Castings

MR. H. MORRIS (Ashton-under-Lyne) inquired whether Mr. Blakiston used chills in his practice, and had he any experience of high-duty irons being used for centrifugal processes? If so, what was the effect upon the structure, and on the Brinell hardness under those conditions.

High-Duty Grey Iron as Substitute

MR. BLAKISTON had no experience of acicular irons running against chills, but on normal high-duty irons, especially those of the lower carbon range, it was possible to run a metal on chills without any fear of trouble due to hard chilling. He would imagine that the acicular irons, if run on chills, would produce an exceedingly hard metal; in fact, he thought that similar analyses were used for the production of the superhard chill rolls for rolling sheets, but he could not state this definitely.

MR. W. C. COLLINS (Little Lever) asked what was the temperature at which to cast, and in the event of using ferro-silicon, what margin was allowed for temperature. If something unforeseen happened during melting practice, and the temperature was not quite reached and there was inoculation with silicon, what would be the result? Would Mr. Blakiston scrap the metal or would he take a chance? What was the reason for the average wasters? Was it gasholes? He did not suppose there would be any sponginess.

MR. BLAKISTON said that the whole idea in the production of high-duty iron was to produce hot metal from the cupola. If it came out cool, then discard it—it was useless proceeding further with it, as nothing but trouble would ensue. The whole idea of the Paper was to impress upon everybody the necessity for taking the metal from the cupola regularly at a consistently high temperature. The bulk of wasters in the manufacture of high-duty iron wasters were caused neither by the metal nor by the melt; but because either the core-making was incorrect or through the painting of cores and damp runners and damp runner boxes.

High-steel mix irons were very susceptible to excess moisture conditions. The freezing point, also, was very sharp, so that if any mishap or bubbles occurred on the mould through incorrect core manufacture or incorrect venting from cores, the metal was dead before it had time to recover its position in the mould. He might say, confidently, that 80 per cent. of the wasters in big castings, made in high-duty irons, were caused by incorrect core manufacture. In answer to another speaker, Mr. Blakiston said that a good proprietary blacking on a dry sand job, with reasonable melting, was all that was required of a suitable refractory nature.

Composition Control

MR. A. L. KEY (Manchester) asked whether it had been ascertained if there was any variation in the composition of high-steel mix, or, in other words, in the handling of high-duty cast irons. He mentioned this because he had tried it out himself. Usually, the first seven charges tapped very regularly, and then he had found a progressive change which might be negligible, but still it occurred. In one instance, it was a high-steel mix of 30 per cent. steel, where 5 per cent. silicon was required. It was found the further one progressed with the blow—and this was contrary to Mr. Blakiston's statement—that the steel melted first, and the silicon gradually increased; as a matter of fact, it had proved to be as high as 6½ per cent. in the same charge weighed on to the cupola. Everything, of course, was weighed. For the first two charges there would be exactly what they wanted; but later the silicon rose as the process continued. It had reached 6½ per cent., which defeated the object in view. Had Mr. Blakiston checked up at all with a view to getting an absolutely constant composition throughout the blow.

MR. BLAKISTON thought the trouble mentioned by Mr. Key was due to inconsistent scrap size and to too large charges. It was entirely a matter of experiment in order to arrive at the best melting conditions, but variable scrap size would cause variable composition. The smaller the charges, and the more consistent the size and quality of the materials, and the steadier the analysis. Thus he graded the material throughout the melting process.

Heat-Treatment Advocated

MR. H. P. HUGHES said that his experience was the very opposite. His figures proved that heat-treatment was worth while. He had the benefit of heat-treatment facilities in the machine shop, which was an advantage others might not have. There was definitely no decrease in tensile strength if heat-treatment was carried out properly. There was an appreciable increase. A casting which might give 25 tons in the as-cast condition would give 35 tons in the heat-treated condition, which in itself demonstrated the advantage to be gained by heat-treatment. A point had been raised concerning varying thicknesses in castings ¼ in. and 3 in. There was a casting being made of that variation in thickness in high-duty cast iron without using chills, and it was being produced without any difficulty.

Vote of Thanks

MR. F. GATER (Bury) and MR. ALEXANDER J. DAVIDSON (Liverpool) voiced the thanks of the members to the lecturer.

PRODUCTION OF BRONZE CASTINGS

(*Concluded from page* 76.)

with consequent embrittlement. This latter alloy is not to be recommended for the production of high strength die castings.

In concluding this Paper, the Author desires to express his thanks for the very ready help afforded by the Phosphor Bronze Company, Limited, in conducting many of the practical tests outlined in connection with the use of inert atmospheres, and to Messrs. Starkie, Gardner & Company, Limited, for allowing him to so freely illustrate some of the practices of that firm.

WASTE PAPER FOR MORE MUNITIONS

INSTITUTE OF BRITISH FOUNDRYMEN

NEW MEMBERS

At a meeting of the Council of the Institute of British Foundrymen, held at the Grand Hotel, Bristol, on January 16, the following were elected to the various grades:—

Subscribing Firm Members

Dening & Company (1937), Limited, Crimchard Works, Chard, Somerset (representative: W. S. Smyth); The Dover Engineering Works, Limited, By Pass Road, Watford, Herts (representative: M. J. Glenny); Fodens, Limited, Elworth Works, Sandbach, Cheshire (representative: G. R. Wilkinson); Hunt Bros. (Oldbury), Limited, Griffin Foundry, Oldbury, near Birmingham (representative: E. Iveson); Westinghouse Brake & Signal Company, Chippenham, Wilts (representative: E. Potts).

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(*Continued overleaf.*)

NEW CATALOGUES

Lapping Compounds.—The Carborundum Company, Limited, Trafford Park, Manchester, 17, has just issued a particularly useful 54-page well-illustrated booklet covering the subject of the lapping of surfaces from moving angles. Not only are steel, cast iron and non-ferrous problems dealt with, but the research, which forms the basis of the booklet, has been extended to cover plastics. The system followed has been devoted in the first few pages to a general study of the subject, followed by detailing the processes to be followed when dealing with twenty different types of components. Finally, two pages are given over to polishing metals to high finishes. So long as supplies last, this booklet is available to our readers who write to Trafford Park, and this action is recommended, as the booklet makes a very useful contribution to a subject about which real data are available.

High Temperature Thermal Insulating Firebricks. Three leaflets received from Kingscliffe Insulating Products, Limited, Sandiron House, Beauchief, Sheffield, 8, give, by means of plan and illustration, graphs and technical data, much interesting and useful information about two types of insulating firebrick. These are known as K.I.P. Alumina and K.I.P. Hyper. The latter has a density of only 30 lbs. per cub. ft., and so is somewhat comparable with diatomite bricks, but possesses a much higher working temperature. The former is a standard hot face insulating brick of slightly inferior heat conducting properties, but, of course, much stronger and more highly refractory.

Convection Heating for Mould Drying.—Foundry Refractories, Limited, of 9, Midland Road, Wellingborough, has issued a two-page circular covering a convection heating system for drying moulds and cores, using recirculated air.

INSTITUTE OF BRITISH FOUNDRYMEN

(*Concluded from previous page.*)

planning engineer, Audley Engineering Company, Limited; D. A. Stark, assistant foundry foreman, Coltness Iron Company, Limited; S. Taylor, steel castings estimator, English Steel Corporation, Limited; A. Tingle, assistant foreman patternmaker, English Steel Corporation, Limited; A. W. Walker, assistant metallurgist, Power Jets, Limited; C. F. Wyard, engineering draughtsman, Crane, Limited; J. E. Allcock, foreman, H. Sampson & Sons; V. R. Conibear, foreman patternmaker, H. Sampson & Sons; M. J. D. Kennedy, assistant metallurgist, Powell Duffryn Assoc.; W. C. Ling, company secretary, H. Sampson & Sons; J. McMullen, metallurgist, High Duty Alloys; G. Nicholas, steel moulder; W. H. Richardson, metallurgist, Langley Alloys, Limited.

Associates

A. C. Webster, wood and metal patternmaker (apprentice), Rolls-Royce, Limited; W. R. Allen, foundry engineering apprentice, Birmingham Aluminium Castings.

INSTITUTE OF METALS MEDAL

AWARD TO DR. HAROLD MOORE

The Institute of Metals Medal for 1943 has been awarded to Dr. Harold Moore, C.B.E., a Fellow of the Institute, and President in 1934-36. He has had a long and distinguished metallurgical career, and will receive the medal as one who has rendered "outstanding services to non-ferrous metallurgy." Dr. Moore has been Director of the British Non-Ferrous Metals Research Association since 1932. Following his training under Dr. J. E. Stead, F.R.S., he held metallurgical posts with industrial firms before joining, as Chief Metallurgist, the Research Department, Woolwich, of which he was Director of Metallurgical Research from 1919 to 1932.

The medal, which is offered to the Council of the Institute by the Mond Nickel Company, Limited, for award annually, is of pure platinum, the metal of which it is composed being prepared at the company's London refinery. This is the sixth occasion on which the medal has been presented, previous recipients having been the late Sir William Bragg (1938), the late Sir Harold Carpenter (1939), Dr. Paul Merica (1940), Dr. C. H. Desch (1941), and Mr. W. Murray Morrison (1942). The medal will be presented to Dr. Moore on the occasion of the annual general meeting to be held in London on March 3.

PERSONAL

MR. ROBERT L. ANGUS, chairman of William Baird & Company, Limited, and of Bairds & Dalmellington, Limited, and a director of Bairds & Scottish Steel, Limited, has been elected a director of the Midland Bank.

MR. G. GLENN, of Tinsley Wire Industries, Limited, was elected president of the Sheffield Metallurgical Association at the recent annual meeting. Mr. Glenn is a founder member of the Association and a Sorby prizewinner.

MR. H. C. HARLAND has been elected president of the London Master Builders' Association, in succession to Mr. W. E. Rice. Mr. Harland, a director of John Laing & Son, Limited, has been a member of the Council of the L.M.B.A. since 1929.

MR. J. W. RODGER, M.I.E.E., director and chief engineer of Bruce Peebles & Company, Limited, engineers, Edinburgh, has been appointed general manager of the company as from January 14. Mr. W. H. Morton, secretary, has been appointed a director of the company. He retains the secretaryship.

MR. ATHOLL BLAIR (manager of the engine works at Belfast), MR. JOHN MORRISON (manager of the Belfast shipyard), MR. L. V. DUNLOP (general manager of the yard and engine works at Govan, Glasgow), and MR. F. V. SPARK (chief accountant) have been appointed directors of Harland & Wolff, Limited, shipbuilders and engineers, in recognition of their long and outstanding services.

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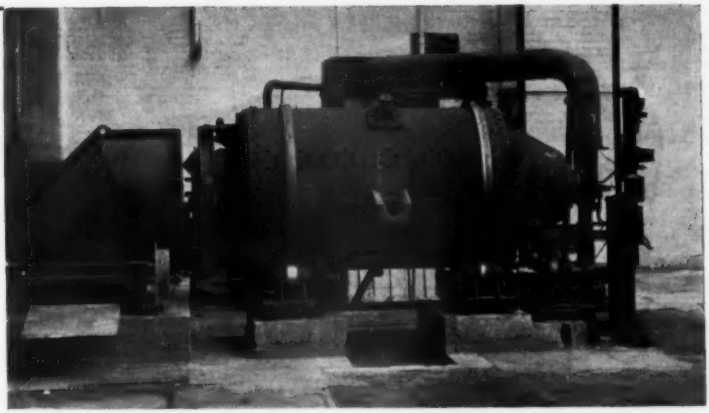

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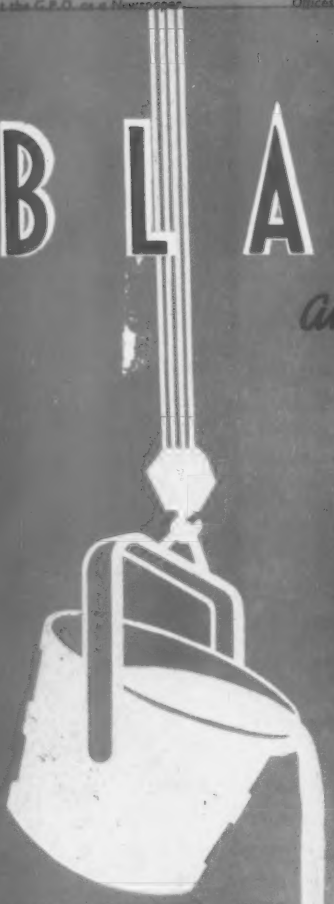

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